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**Forest Pest
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**Methods
Application
Group**

Fort Collins,
Colorado 80526



THE FOREST PEST MANAGEMENT NATIONWIDE AERIAL PHOTOGRAPHY PROGRAM

— FIRST YEAR ACCOMPLISHMENTS —



THE FOREST PEST MANAGEMENT NATIONWIDE
AERIAL PHOTOGRAPHY PROGRAM
- First Year Accomplishments -

by

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ABSTRACT

An aerial photography program has been established to provide technical support to Forest Pest Management nationwide. The program is administered by the Methods Application Group and is designed to handle small, specialized photo mission requirements that were previously difficult to fulfill or were not being met at all.

Logistics and procedures were established for administering the program and for the planning and scheduling of photo missions. A Forest Service aircraft was dedicated to the photo program and has been equipped with a mapping camera and related equipment. During the 1983 field season (June through September), 15 photo missions were scheduled. All missions were successfully completed.

INTRODUCTION

Color and color infrared aerial photography is a valuable tool for assessing pest activity on forest lands. Aerial photography is used to: (1) estimate current and/or total levels of damage or mortality; (2) monitor rate of spread and trends of infestations; and, (3) under certain conditions, to evaluate the effects of treatment by either chemical, biological, or cultural means, in terms of vegetation damage prevented.

A dedicated photo capability was needed to fulfill special forest pest management requirements such as critical timing of photo acquisition, quick response to unpredicted events, and evaluating aerial photography in new applications.

Since 1983 was the first year of operation of the nationwide Forest Pest Management aerial photo acquisition program, it is appropriate to report the accomplishments of this new program.

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BACKGROUND - In 1982 an agreement was made to reassign a Forest Service aircraft from the Rocky Mountain Region (R-2) to a Washington Office Forest Pest Management (FPM) detached unit, the Methods Application Group (MAG) located in Fort Collins, Colorado. The aircraft was removed from the Working Capital Fund and designated as a special project aircraft dedicated to aerial photography. An approved Memorandum of Understanding between R-2, FPM/MAG, the Rocky Mountain Forest and Range Experiment Station, and Fiscal and Accounting Management/Washington Office, was developed to cover the administration of this aircraft. R-2's Aviation Management (Denver, Colorado) provides photo pilots and arranges for aircraft maintenance.

PHOTO PROGRAM - The aerial photography program administered by FPM/MAG is designed to handle small, specialized aerial photo missions required by Forest Pest Management. The program was established to meet the following special FPM requirements that were previously difficult to fulfill or were not being met at all:

1. Timing of photo acquisition is critical for capturing insect or disease damage symptoms at their peak (often as short as several weeks). The biological window for peak detection can vary from year to year, depending on phenology and weather. Timing requires close coordination between the aerial photographer and the local pest management staff.

2. Unusual requirements, i.e., sampling photography, locating established ground plots instead of large area continuous photo coverage.

3. Quick response to unpredicted events (such as catastrophic insect and disease outbreaks, severe storm damage, etc.) is difficult through commercial services due to time-consuming contract procedures.

4. New situations often arise where aerial photography may be useful in assessing a pest related problem. Time and money can be lost by embarking on an operational photo mission when the photo parameters, i.e., film type, scale, etc., have yet to be proven successful. Control must be maintained when conducting a feasibility test for using aerial photography in a new application.

For these reasons it is difficult to contract for forest pest management related aerial photography in the private sector.

The overall mission of this photo program is to provide professional support and advice to FPM staffs nationwide to aid them in accomplishing Region/Area goals and objectives.

AIRCRAFT AND CAMERA SYSTEM - A Beechcraft Queen Air B-80 (N128Z)^{2/} is utilized for aerial photo acquisition (Fig. 1). The Queen Air is equipped with autopilot, deicing equipment, weather radar, and a camera port with a sliding door. Special mounts were designed to accommodate a mapping camera system in the existing camera port.

^{2/}Mention of commercial products is for convenience only and does not imply endorsement by USDA Forest Service.



Figure 1 - Beechcraft Queen Air (N128Z), the Forest Service aerial photo aircraft.

The camera system (Fig. 2) is a Zeiss RMK 21/23 9-inch format mapping camera with a 210 mm (8-1/4 inch) focal length lens. Proper interval/overlap between photos is controlled with a Zeiss IRU Intervalometer System linked to the camera. Visual navigation is performed with a Zeiss NT-1 Navigation Telescope which is also used to determine amount of drift for setting the camera for crab correction.

ACCOMPLISHMENTS

AVIATION OPERATIONS PLAN - In May 1983 an Aviation Operations Plan was prepared and approved (Myhre 1983). The detailed plan covers organization and responsibilities, operational policies, dispatching and controlling flights, records and reports, and emergency procedures for overdue or missing aircraft.

LOGISTICS AND PROCEDURES - An aerial photo mission requires coordination of the aircraft, flight crew, and camera equipment; plus scheduling to meet critical biowindow requirements, and film processing for rapid turnaround time. The flow chart (Fig. 3) shows the procedures that were established for the planning and scheduling of photo missions:

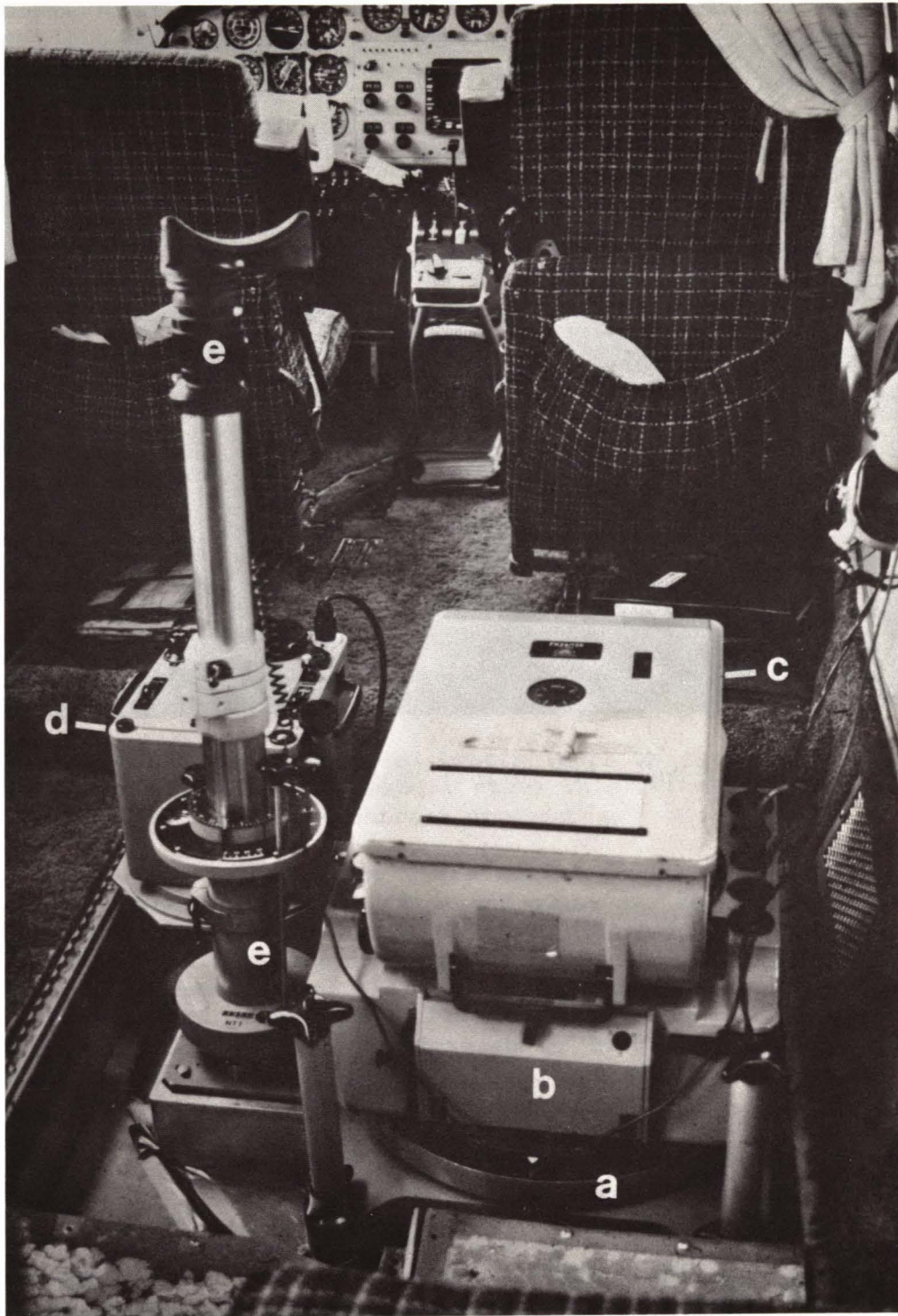


Figure 2 - Interior of Queen Air showing camera system: (a) camera mount; (b) camera; (c) film magazine; (d) intervalometer system; (e) navigation telescope.

PHOTO PROGRAM LOGISTICS AND PROCEDURES

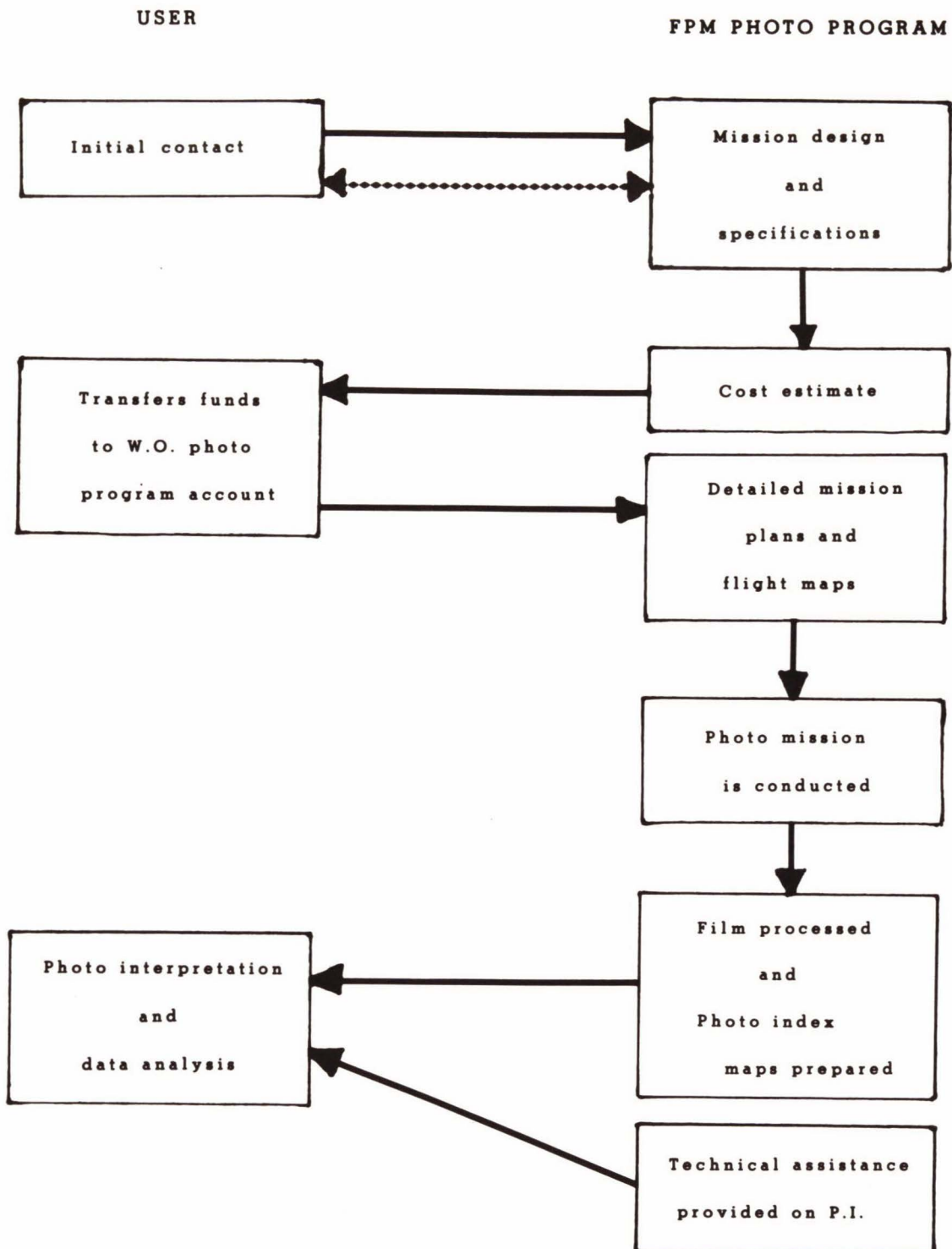


Figure 3 - The step-by-step process in the operation of the photo program, and the interaction between the user and the FPM photo program.

1. User makes an initial contact with the MAG staff. The user's pest problem and needs are discussed, and a photo mission design and specifications are determined based on an exchange of information and knowledge between the user and MAG.

2. A photo mission cost estimate is prepared and a written copy sent to the user.

3. The user organization then transfers funds through MAG to a special account, established by Fiscal and Accounting Management, in the Washington, D.C. office via established Forest Service fiscal procedures (an In-Service Authorization, Form 6500-46).

4. Detailed mission plans and flight maps are prepared.

5. The aerial photographer/aviation officer coordinates and schedules the aircraft and photo pilot with R-2 Aviation Management and the R-2 dispatcher.

6. MAG carries out the photo mission, arranges for film processing, and prepares photo coverage index maps.

7. Film and index maps are sent to the user.

8. If the user requests advice and assistance with photo interpretation, technical assistance is provided by the MAG staff.

1983 PHOTO MISSIONS - During the period of June through September 15, photo missions were flown nationwide in five Regions of the Forest Service and on 12 National Forests (Fig. 4). All of the planned photo missions were successfully completed. A brief description of each photo mission follows:

1. Ochoco National Forest and

2. Fremont National Forest, Oregon:

Approximately 95 sample points on each forest were photographed with color transparency film at a scale of 1:6,000. This sampling photography is being used by R-6/FPM for conducting a fir mortality inventory and root disease assessment.

3. Siskiyou National Forest, Oregon:

Plantations and seed orchards were photographed with 1:4,000 color transparency film for assessing root diseases. The photography will be used by the Siskiyou National Forest and R-6/FPM.

4. Payette National Forest and

5. NezPerce National Forest, Idaho:

A pilot project of a pheromone, MCH, to prevent Douglas-fir beetle attack is being evaluated with 1:8,000 scale color photography - a cooperative effort between R-1/FPM and MAG.

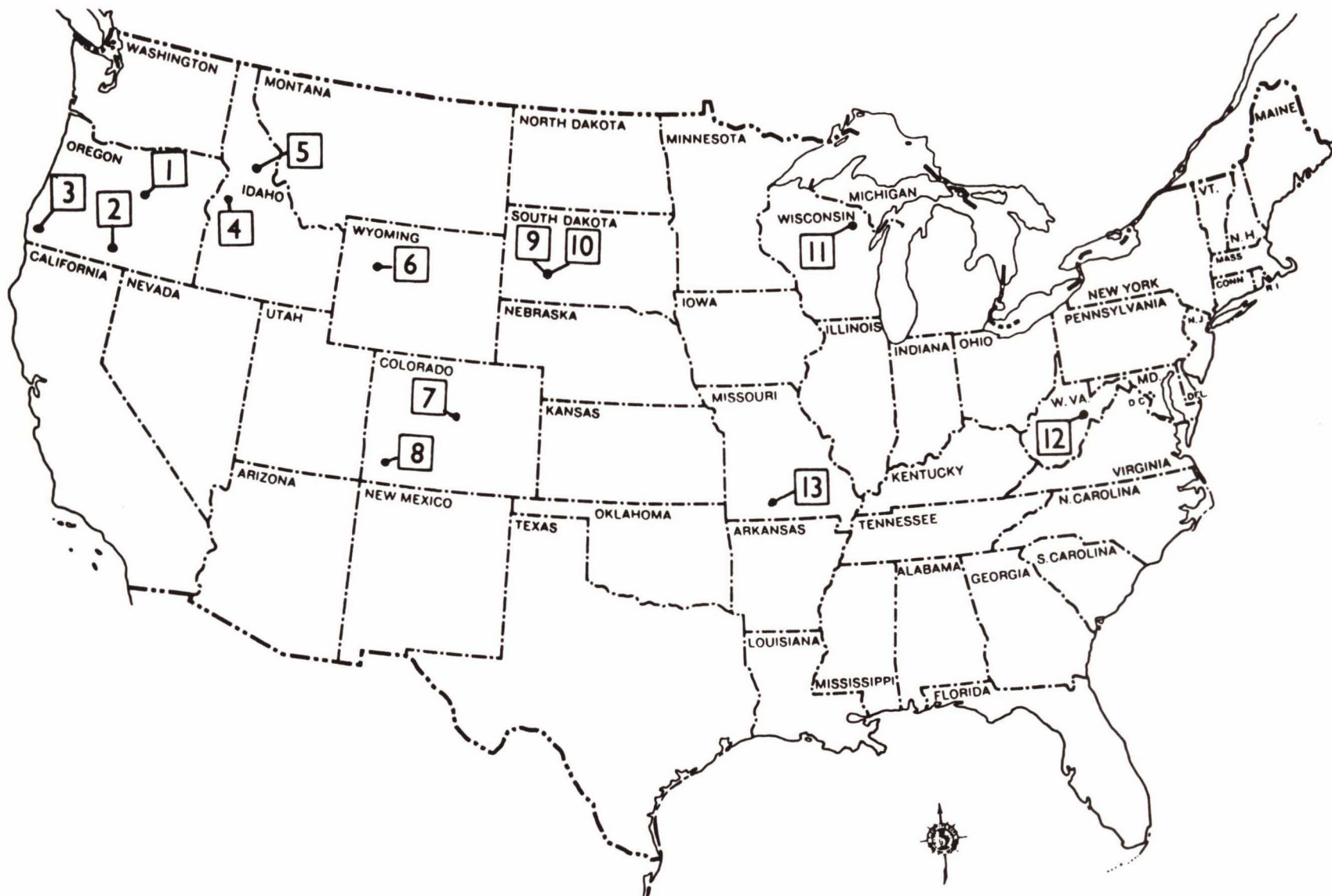


Figure 4 - Locations of all photo missions flown in 1983 - see text for a brief description of each mission.

6. Shoshone National Forest, Wyoming:

Aerial photography will be used to evaluate thinning intensities for preventing mountain pine beetle infestations - a cooperative effort between the Intermountain Forest and Range Experiment Station and MAG.

7. Pike National Forest, Colorado:

1:6,000 scale color infrared photography was acquired of one compartment to determine the location and extent of current mountain pine beetle damage. This information will be added to the Geographic Information System being developed with the Pike National Forest.

8. San Juan National Forest, Colorado:

Three areas were flown with color film at 1:16,000 scale to evaluate brush control and treatment in plantations.

9. Buffalo Gap National Grassland, South Dakota:

A portion of the Buffalo Gap National Grassland, which is administered by the Nebraska National Forest, was photographed with color infrared at 1:16,000. This photography will be used to assess the present status of prairie dog towns (numbers and acres) and what changes have occurred due to control efforts.

10. Buffalo Gap National Grassland, South Dakota:

Aerial photography will be used in a feasibility study to relate vegetation conditions to the level of activity in prairie dog towns for assessing recovery of areas treated with Zinc Phosphide bait. Aerial photos were acquired in June, July, and August (three separate photo missions) with color and color-IR at scales of 1:4,000; 1:8,000; and 1:16,000. This study is a joint effort between the Rocky Mountain Forest and Range Experiment Station (Rapid City), Nebraska National Forest, and MAG.

11. Nicolet National Forest, Wisconsin:

Forty sample plots (stands) were photographed with color film at a scale of 1:6,000. This photography will be used in a special project to evaluate four methods of determining spruce-fir mortality caused by eastern spruce budworm. This is a cooperative effort between the Northeastern Area/FPM, St. Paul Field Office; Nicolet National Forest; CANUSA East; and MAG.

12. Monongahela National Forest, West Virginia:

Large scale (1:6,000) color-IR aerial photos were acquired to support an inventory to determine the distribution and extent of beech mortality caused by beech bark disease. This is a cooperative inventory between the Northeastern Area/FPM, Morgantown, West Virginia Field Office, and MAG (Mielke, et al. 1984).

13. Mark Twain National Forest, Missouri:

1:8,000 color-IR photography was acquired over a portion of the Mark Twain National Forest to determine the feasibility of using aerial photography to assess the distribution and extent of oak mortality.

NAVIGATION SYSTEM INSTALLED IN PHOTO PLANE - A new component has been added to the Beechcraft Queen Air photo plane - a Loran-C Navigation System. The ARNAV Loran system has many special features - storage capacity for 200 way points, in-flight recalibration function, and variable accuracy level assignments for the course deviation indicator.

With the integration of the Loran-C into the aerial photo acquisition system, the photo program can be more efficient and cost effective. One area where flight costs can be reduced and valuable time saved is in locating and photographing ground plots in some type of sampling design. The navigation equipment was purchased with funds provided by MAG and the Pacific Northwest Forest and Range Experiment Station Forest Inventory and Analysis Project in Alaska.

PHOTO PROGRAM SUMMARY - (for the period June 1 - September 30, 1983) -

Total air miles flown -----	9,100 miles
(does not include miles of flight line)	
Total hours logged on Queen Air -----	110 flight hours
Number of travel days on photo missions -----	52 days
Range of operation in 1983 -----	5 Regions
	12 National Forests
Total funds acquired by in-service authorizations and MAG funds (based on pre-mission estimates) -----	\$45,500.00
Total cost of all photo missions (includes aircraft operation, salary, travel, film purchase, film processing, etc.) -----	\$45,717.85

VOLUME AND TYPES OF AERIAL FILM USED (9-1/2 inch wide roll film) - Color and color infrared films were used for pest problem detection and assessment. The application of a particular film to a given problem depends on the specific pest and host vegetation type being evaluated, and amount of atmospheric haze in a photo area. The following films were used on last year's photo missions:

Color (Ektachrome EF, type SO-397) -----	1,600 feet
Color Infrared (Aerochrome IR, type 2443) -----	1,400 feet
Color negative (Aerocolor Neg., type 2445) -----	<u>300 feet</u>
TOTAL -----	3,300 feet
	(or .6 mile)

PHOTO SCALES USED - All photography acquired last summer can be grouped into two types of photo coverage and a corresponding group of photo scales:

Block areas (large areas with parallel flight lines) ----- 1:16,000
 Photo sampling designs (small block, plots, etc.) ----- 1:4,000-1:8,000

VISUAL NAVIGATION AIDS - The selection of map or photo products for navigation aids depends on what products are available for the photo area and the photo mission design and requirements. The following aids were used for visual navigation:

USGS Topographic maps -
 7-1/2 minute series ----- 1:24,000
 15 minute series ----- 1:62,500
 USFS Recreational maps ----- 1:126,720
 Black and white photo prints ----- 1:60,000 and
 1:80,000.

Black and white aerial photos have proven to be the best visual navigation aid for locating sample areas or plots, especially when acquiring larger scales of photography.

DISCUSSION

The first year of any new program is usually the most difficult, especially when new logistical and administrative procedures must be established. The accomplishments to date speak for the photo program's first year attempts. The program has received good support from both the Washington Office and numerous field units.

The 1984 photo season promises to be an even more productive year with a number of missions already scheduled and a major increase in aircraft flight hours anticipated.

ACKNOWLEDGMENTS

FPM/MAG wishes to express its appreciation to Tex Wright, R-2 Aviation Management, for providing photo pilots and maintenance of the Queen Air. A very special thanks to pilots Ron Bell and Bob Hedrix for their support and expertise in flying all photo missions. Aerial photography must be a team effort between pilot and photographer, and without the help of Ron and Bob the summer would not have been as productive as it was. Thanks are also extended to Eleanor Franz, Program Assistant, MAG, for the administrative aspects (accounting, purchasing, shipping of film, etc.) of the photo program.

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